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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
EGAN, BRIAN P	
ART UNIT	**PAPER NUMBER**
1772	

DATE MAILED: 02/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/045,924	Applicant(s) GREENWOOD ET AL.	
	Examiner Brian P. Egan	Art Unit 1772	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 November 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-74* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-74* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-6, 9-25, and 28-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bergerson (#6,090,484) in view of Shores (#5,061,549).

Bergerson teaches a laminar, thermally-conductive interface interposable intermediate a first heat transfer surface and an opposing second heat transfer surface to provide a thermally-conductive pathway therebetween (see Abstract), said interface having a first interface surface disposable in heat transfer contact with the first heat transfer surface (Fig. 1, #11) and an opposing second interface surface disposable in heat transfer contact with the second heat transfer surface (Fig. 1, #12), the interface comprising a first layer formed of a flexible lamellar graphite material (which is broadly inclusive of intercalated graphite flake) (see Abstract; Col. 2, lines 18-21), the first layer having a first interior surface and a first exterior surface defining the first interface surface of the interface (see Fig. 1), and a second layer formed of a phase-change material (Col. 4, lines 6-10), the second layer having a second interior surface joined to the first interior surface of the first layer and a second interface surface defining the second interface surface of the interface (see Fig. 1). The interphase material is form-stable at normal room temperature in a first phase and conformable to the second interface surface in a second phase (Col. 5, lines 22-30), the phase-change material having a transition temperature above normal

room temperature from the first phase to the second phase (Col. 4, lines 6-10). The first heat-transfer surface is located on a heat-generating source having an operating temperature above normal room temperature (Col. 1, lines 54-60) and the transition temperature of the phase-change material is within the operating temperature of the heat-generating source (Col. 4, lines 6-10). The transition temperature of the phase change material is between about 40 and 80 degrees Celsius (Col. 4, lines 6-10). The heat generating source is an electronic component and the second heat transfer surface is located on a thermal dissipation member such as a heat sink or circuit board (see Abstract). Given that the phase-change material comprises a hot-melt adhesive, the phase-change material is inherently tacky such that the second exterior surface thereon is adherable by the phase-change material to the second heat transfer surface (Col. 5, lines 22-30). The phase change material comprises an admixture of a polymeric components comprising one of more resins, one or more waxes, or a blend of one or more waxes and one or more resins (Col. 5, lines 22-30). The resins and/or waxes are selected from thermoplastics, pressure sensitive adhesives, paraffinic waxes, and blends thereof (Col. 5, lines 22-30). The interface has a thermal impedance of less than about 1 $^{\circ}C\text{-}in^2/W$ and a thermal conductivity 3.0 W/m-K (Col. 6, lines 7-11). Given that the thermal impedance is 0.09 $^{\circ}C\text{-}in^2/W$, both the first and second layers implicitly comprise thermal impedances within the Applicant's claimed ranges in claims 18 and 19. Finally, the thickness of the first layer is 6 mils (Col. 4, lines 41-42).

Although it is implicit that the adhesive layer is conductive, Bergerson fails to teach that the second layer is thermally conductive by means of a thermally conductive filler. Bergerson also fails to teach that the thickness of the second layer is between 2 and 20 mils.

Shores, however, teach a hot-melt adhesive for electronic applications that may optionally comprise up to 45% (see Abstract) of a thermally conductive inorganic filler selected from the group consisting of silver, gold, alumina, beryllia, silica, silicon carbide, barium titanate, steatite, boron nitride, and aluminum nitride (Col. 3, line 68 to Col. 4, line 3). In electronic applications, Shores teaches that the thickness of the adhesive layer should be limited between 2 and 15 mils since a thickness below 2 mils results in voids in the bond between the adhesive and electronic application and a thickness in excess of 15 mils takes up too much space in a microcircuit device and insulates it thermally (Col. 2, lines 31-41). Shores teaches the use of the thermally-conductive additive for the purpose of providing the adhesive with an improved thermal conductivity, i.e., between 0.7 and 4 W/m °C, while also preventing deterioration of the adhesive properties of the hot-melt adhesive (Col. 3, lines 49-61 and Col. 4, lines 5-9). It would have been obvious to one of ordinary skill in the art at the time Applicant's invention was made to have combined the teachings of Bergerson and Shores since both of the aforementioned references are analogous insofar as providing adhesive thermal interface substrates in order to facilitate heat dissipation from an electronic application.

Therefore, it would have been obvious to one of ordinary skill in the art at the time Applicant's invention was made to have modified Bergerson by including up to 40% thermally conductive filler as well as limiting the thickness of the adhesive layer between 2 and 15 mils as taught by Shores in order to provide the adhesive with an improved thermal conductivity, i.e., between 0.7 and 4 W/m °C, prevent deterioration of the adhesive properties of the hot-melt adhesive, and to provide an adhesive free of voids at the connection interface without being too cumbersome.

3. Claims 7-8 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bergerson ('484) in view of Shores ('549), and further in view of Oeltjen et al. (#6,433,069),

Bergerson and Shores teach a thermally conductive interface as detailed above. The aforementioned prior art is silent as to whether the interface is cleanly releasable from the electronic components. It is notoriously well known in the hot-melt adhesive art, however, that plasticizing oil may be added to the hot-melt adhesive composition in order to form a removable hot-melt adhesive that allow separation of the adhesive from an attached substrate without substrate failure or adhesive failure as evidenced by Oeltjen et al. (Col. 1, lines 40-52). It would have been obvious to combine the teachings of Bergerson, Shores, and Oeltjen et al. since each of the aforementioned references are analogous insofar as each of the three references are directed at the formation of hot-melt adhesives.

Therefore, it would have been obvious to one of ordinary skill in the art at the time Applicant's invention was made to have modified the adhesives of Bergerson and/or Shores by including plasticizing oil as taught by Oeltjen et al. in order to impart repositionable properties to a hot-melt adhesive such that the adhesive is removable from an attached substrate without substrate failure or adhesive failure.

4. Claims 39-44, 47-62, and 65-74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bergerson ('484) in view of Shores ('549) and Columbier et al. (#5,100,737).

Bergerson and Shores teach a thermally conductive interface as detailed above. The aforementioned prior art fails to teach a first layer comprising a tin foil material.

Columbier et al., however, teach a flexible graphite substrate for electronic applications wherein the graphite substrate is reinforced with electroplated metal layers (including iron) (Col.

2, line 34-42; Col. 4, lines 27-34) thereby creating a graphite substrate reinforced with metal foil. Columbier et al. teach the use of the metal reinforcement for the purpose of improving the mechanical strength of the substrate while also reducing the electrical resistance and enhancing thermal conductivity of the substrate (Col. 2, lines 34-42; Col. 4, lines 27-38). It would have been obvious to one of ordinary skill in the art at the time Applicant's invention was made to have combined the teachings of Bergerson, Shores, and Columbier et al. since each of the aforementioned references are analogous insofar as being directed to thermal interface substrates.

Therefore, it would have been obvious to one of ordinary skill in the art at the time Applicant's invention was made to have modified Bergerson and Shores by reinforcing the graphite layer of Bergerson with metal foil (including tin) as taught by Columbier et al. in order to improve the mechanical strength of the substrate while reducing the electrical resistance and enhancing thermal conductivity of the substrate.

5. Claims 45-46 and 63-64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bergerson ('484) in view of Shores ('549) and Columbier et al. ('737), and further in view of Oeltjen et al. ('069).

Bergerson, Shores, and Columbier et al. teach a thermally conductive interface as detailed above. The aforementioned prior art is silent as to whether the interface is cleanly releasable from the electronic components. It is notoriously well known in the hot-melt adhesive art, however, that plasticizing oil may be added to the hot-melt adhesive composition in order to form a removable hot-melt adhesive that allow separation of the adhesive from an attached substrate without substrate failure or adhesive failure as evidenced by Oeltjen et al. (Col. 1, lines 40-52). It would have been obvious to combine the teachings of Bergerson, Shores, Columbier

et al., and Oeltjen et al. since each of the aforementioned references are analogous insofar as each of the four references are directed at the formation of hot-melt adhesives and/or the formation of thermal interface substrates.

Therefore, it would have been obvious to one of ordinary skill in the art at the time Applicant's invention was made to have modified the adhesives of Bergerson and/or Shores by including plasticizing oil as taught by Oeltjen et al. in order to impart repositionable properties to a hot-melt adhesive such that the adhesive is removable from an attached substrate without substrate failure or adhesive failure.

Response to Arguments

6. Applicant's arguments filed November 17, 2003 have been fully considered but they are not persuasive.

First, however, the Examiner notes that the 35 U.S.C. 112 rejections and claim objections from the previous office action have been withdrawn pursuant to the Applicant's amended claims and remarks.

With regards to the rejection of claims 1-6, 9-25, and 28-38 under 35 U.S.C. 103(a) over Bergerson ('484) and Shores ('549), the Applicant's primary contention is that Bergerson already exhibits a sufficient thermal impedence for the desired purpose and Bergerson, even if modified, would desire additional filler material in the cured silicone polymer rather than the adhesive layer since adding filler to the adhesive would reduce the adhesive layer's ability to bond. The Examiner respectfully disagrees. First, with regards to thermal impedence, the Applicant has submitted no evidence that modifying Bergerson in view of Shores would harm

the thermal impedence of the substrate and it is clear from Shores that the addition of filler material into the adhesive layer improves the conductivity. Therefore, Shores provides a comparative advantage over Shores -- just because a thermal impedence may be "sufficient" does not preclude modifying a substrate to improve its thermal conductivity. Even if the thermal impedence were to worsen through modification of the substrate, the trade off between thermal conductivity versus thermal impedence still weighs in favor of modifying Bergerson in view of Shores. Second, with regards to modifying the silicone polymer layer rather than the adhesive layer in order to prevent degradation of the adhesive properties, Shores explicitly prevents the degradation of the adhesive through use of a specific thickness of adhesive. Shores states that "the new adhesive . . . is a self supporting, heat activated film of 2-15 mil in thickness . . . if the thickness is less than 2 mil, the resulting bond may have voids . . . voids decrease adhesive bond strength and heat transfer." (Col. 2, lines 31-38). Therefore, by keeping the thickness of the adhesive layer in excess of 2 mils, a decrease in adhesive bond strength is prevented. Therefore, not only does Shores prevent any degradation of adhesive properties, the modification of Bergerson in view of shores would provide a comparative advantage over the teachings of Bergerson alone insofar as a substrate with conductive particles in both layers will provide a substrate exhibiting improved conductivity across the entire substrate.

With regards to the Applicant's remarks concerning the rejection of claims 39-44, 47-62, and 65-74 under 35 U.S.C. 103(a) over Bergerson, Shores, and Columbier et al. ('737), the Applicant's primary contention is that Columbier et al. fail to teach an embodiment wherein a tin foil layer can be joined to a surface of a phase change material. The Examiner respectfully disagrees. Although Figures 1-7 of Colombier et al. depict substrates comprising flexible outer

layers "C" which would preclude the foil layer from contacting an attached adhesive, Colombier et al. also teach embodiments in which the foil layer may be arranged as the outermost layer (see Col. 4, lines 48-52 – "C/LM/C/M . . . C/LM/M/C/M . . . C/LM/C/M/LM . . . [and] C/LM/M/C/LM"). Therefore, Columbier et al. teach embodiments in which the foil layer can be directly adhered to the phase change material. Furthermore, the Applicant's use the open claim language "comprising." Thus, the mere fact that Columbier et al. teach arrangements with a metal layer deposited on a flexible graphite substrate does not preclude the flexible graphite substrate from being defined as part of the first interface surface. If the Applicant intends for the first interface surface to be only a single foil layer, the Examiner suggests defining the substrate using "consisting of" to properly limit the claims.

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian P. Egan whose telephone number is 571-272-1491. The examiner can normally be reached on M-F, 8:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Harold Y. Pyon can be reached on 571-272-1498. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Brian P Egan 2/3/04
BPE

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1772
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